

Philadelphia Workshop Report

Introduction

A partial Port Risk Assessment Workshop was conducted for Philadelphia on December 11 and 12, 2000. The workshop was stopped mid-way through the second day when it became apparent that the PAWSA process would not meet the Philadelphia and Delaware River port community's risk assessment needs. This determination was based on several points raised by the participants during the session: The mariners of the port of Philadelphia have a long history of attention to safety and were among the first in the nation to create their Mariners Advisory Committee (MAC) for the Delaware Bay and River, a forerunner of Harbor Safety Committees. Together with the Ports of Philadelphia, the Marine Exchange, and the Pilots Association for the Bay and River Delaware, they continue to be active proponents for safe and efficient operation of the port. The strong cooperative nature of the port community was recently demonstrated in their development of a port Y2K plan to address potential infrastructure breakdowns. Additionally, the Delaware River was one of the first waterways in the country to be managed through a formalized Vessel Traffic Information Service, with vessel movements facilitated using technologically advanced handheld navigation systems. The port's proactive approach to waterway and vessel traffic management has resulted in an overall feeling that marine transportation system risk is at an acceptable level. The workshop participants, reflecting upon this long-standing history, plus their experience and effectiveness in dealing with port safety issues, found the PAWSA process unsuitable to their needs, as it addresses more macro than micro concerns for port safety. In addition, they expressed a strong fear that workshop results would be used to the commercial disadvantage of the Port of Philadelphia.

The PAWSA methodology will be provided to the Captain of the Port as a risk based decision support tool to assist the COTP in managing future risk, if desired by the port community. While the workshop effort was ended by noon of the second day, participants' input to the national port risk model was recorded for its application there. They also completed the calibration of the risk scale that would have been applied to their more specific risk findings.

This workshop report provides the following information:

- Brief description of the process used for the assessment up to the point when it was terminated;
- List of participants;
- Numerical results from the Analytic Hierarchy Process (AHP) ¹ as it applies to the national model;
- Philadelphia Attributes Summaries.

There will be no Risk Mitigation Strategy Plan report for Philadelphia.

¹ Developed by Dr. Thomas L. Saaty, et. al., to structure complex decision making, to provide scaled measurements, and to synthesize many factors having different dimensions.

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Port Risk Assessment for Philadelphia

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Assessment Process

The risk assessment process is a structured approach to obtaining expert judgments on the level of waterway risk. The process also addresses the relative merits of specific types of Vessel Traffic Management (VTM) improvements for reducing risk in the port. Based on the Analytic Hierarchy Process (AHP), the port risk assessment process uses a select group of waterway users/stakeholders in each port to evaluate waterway risk factors and the effectiveness of various VTM improvements. The process requires the participation of local Coast Guard officials before and throughout the workshops. Thus the process is a joint effort involving waterway user experts, stakeholders, and the agencies/entities responsible for implementing selected risk mitigation measures.

This methodology employs a generic model of port risk that was conceptually developed by a National Dialog Group on Port Risk and then translated into computer algorithms by the Volpe National Transportation Systems Center. In that model, risk is defined as the sum of the probability of a casualty and its consequences. Consequently, the model includes variables associated with both the causes and the effects of vessel casualties. Because the risk factors in the model do NOT contribute equally to overall port risk, the first session of each workshop is devoted to obtaining expert opinion about how to weight the relative contribution of each variable to overall port risk. The experts then are asked to establish scales to measure each variable. Once the parameters have been established for each risk-inducing factor, port specific risk is estimated by putting into the computer risk model specific values for that port for each variable. The computer model allows comparison of relative risk and the potential efficacy of various VTM improvements between different ports.

Numerical Results

Book 1 – Risk Categories (*Generic Weights Sum to 100*)

| Fleet Composition | Traffic Conditions | Navigational Conditions | Waterway Configuration | Immediate Consequences | Subsequent Consequences |
|-------------------|--------------------|-------------------------|------------------------|------------------------|-------------------------|
| 12.3 | 13.4 | 15.7 | 8.5 | 33.3 | 16.8 |

Analysis:

Book 1 begins the process of weighting the national port risk model. The participant teams use their knowledge and the AHP process to provide weights for the six major risk categories. The contribution to the national model by the Philadelphia participants is as listed above. These participants felt that Immediate Consequences was the largest driver of risk. Waterway configuration was a significantly lower influence.

Book 2 - Risk Factors (*Generic Weights*)

| Fleet Composition | Traffic Conditions | Navigational Conditions | Waterway Configuration | Immediate Consequences | Subsequent Consequences |
|-------------------|--------------------|-------------------------|------------------------|------------------------|-------------------------|
| 12.3 | 13.4 | 15.7 | 8.5 | 33.3 | 16.8 |

| % High Risk Deep Draft | Volume Deep Draft | Wind Conditions | Visibility Obstructions | # of People on Waterway | Economic Impacts |
|---------------------------|-------------------------------|-----------------------|-------------------------|-------------------------|-------------------------|
| 10.0 | 5.9 | 1.6 | 1.7 | 13.9 | 3.5 |
| % High Risk Shallow Draft | Volume Shallow Draft | Visibility Conditions | Channel Width | Volume of Petroleum | Environmental Impacts |
| 2.3 | 1.4 | 8.8 | 2.6 | 7.7 | 2.9 |
| | Vol. Fishing & Pleasure Craft | Tide & River Currents | Bottom Type | Volume of Chemicals | Health & Safety Impacts |
| | 1.9 | 2.4 | 1.3 | 11.7 | 10.4 |
| | Traffic Density | Ice Conditions | Waterway Complexity | | |
| | 4.2 | 2.9 | 2.9 | | |

Analysis:

Book 2 further refines the weighting for the national port risk model. The participants examined the importance of the 20 risk factors to port safety and provided the above results to the national model. They determined that the following factors contribute the most to overall risk under each of the six major categories:

- Fleet Composition: High-Risk Deep Draft Vessels are the fourth highest risk factor.
- Traffic Conditions: The Volume of Deep Draft Vessels contributes the seventh highest amount of risk.
- Navigational Conditions: Visibility Conditions contribute the fifth highest amount of risk.
- Waterway Configuration: Waterway Complexity is the eleventh ranking risk factor.
- Immediate Consequences: The Number of People on Waterway contributes the highest amount of risk, while Volume of Hazardous Chemical Cargos is the second highest risk factor. Volume of Petroleum ranks sixth overall.
- Subsequent Consequences: Health and Safety Impacts contribute the third highest amount of risk. Economic Impacts ranked ninth overall.

Book 3 Factor Scales - Condition List (*Generic*) **Scale Value**

Wind Conditions

| | |
|--|-----|
| a. Severe winds < 2 days / month | 1.0 |
| b. Severe winds occur in brief periods | 2.3 |
| c. Severe winds are frequent & anticipated | 4.7 |
| d. Severe winds occur without warning | 9.0 |

Visibility Conditions

| | |
|--|-----|
| a. Poor visibility < 2 days/month | 1.0 |
| b. Poor visibility occurs in brief periods | 2.5 |
| c. Poor visibility is frequent & anticipated | 5.0 |
| d. Poor visibility occurs without warning | 9.0 |

Tide and River Currents

| | |
|---|-----|
| a. Tides & currents are negligible | 1.0 |
| b. Currents run parallel to the channel | 2.1 |
| c. Transits are timed closely with tide | 5.2 |
| d. Currents cross channel/turns difficult | 9.0 |

Ice Conditions

| | |
|---------------------------------------|-----|
| a. Ice never forms | 1.0 |
| b. Some ice forms-icebreaking is rare | 1.8 |
| c. Icebreakers keep channel open | 5.4 |
| d. Vessels need icebreaker escorts | 9.0 |

Visibility Obstructions

| | |
|---|-----|
| a. No blind turns or intersections | 1.0 |
| b. Good geographic visibility-intersections | 1.6 |
| c. Visibility obscured, good communications | 4.2 |
| d. Distances & communications limited | 9.0 |

Channel Width

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- | | |
|---|-----|
| a. Meetings & overtakings are easy | 1.0 |
| b. Passing arrangements needed-ample room | 2.1 |
| c. Meetings & overtakings in specific areas | 6.1 |
| d. Movements restricted to one-way traffic | 9.0 |

Bottom Type

- | | |
|--|-----|
| a. Deep water or no channel necessary | 1.0 |
| b. Soft bottom, no obstructions | 2.0 |
| c. Mud, sand and rock outside channel | 5.0 |
| d. Hard or rocky bottom at channel edges | 9.0 |

Waterway Complexity

- | | |
|--|-----|
| a. Straight run with NO crossing traffic | 1.0 |
| b. Multiple turns > 15 degrees-NO crossing | 2.5 |
| c. Converging - NO crossing traffic | 4.9 |
| d. Converging WITH crossing traffic | 9.0 |

Number of People on Waterway

- | | |
|---|-----|
| a. Industrial, little recreational boating | 1.0 |
| b. Recreational boating and fishing | 3.1 |
| c. Cruise & excursion vessels-ferries | 5.8 |
| d. Extensive network of ferries, excursions | 9.0 |

Petroleum Volume

- | | |
|---------------------------------------|-----|
| a. Little or no petroleum cargoes | 1.0 |
| b. Petroleum for local heating & use | 2.8 |
| c. Petroleum for transshipment inland | 5.4 |
| d. High volume petroleum & LNG/LPG | 9.0 |

Chemical Volume

- | | |
|---------------------------------------|-----|
| a. Little or no hazardous chemicals | 1.0 |
| b. Some hazardous chemical cargo | 2.5 |
| c. Hazardous chemicals arrive daily | 5.5 |
| d. High volume of hazardous chemicals | 9.0 |

Economic Impacts

- | | |
|-----------------------------------|-----|
| a. Vulnerable population is small | 1.0 |
| b. Vulnerable population is large | 3.4 |
| c. Vulnerable, dependent & small | 5.3 |
| d. Vulnerable, dependent & large | 9.0 |

Environmental Impacts

- | | |
|--------------------------------------|-----|
| a. Minimal environmental sensitivity | 1.0 |
| b. Sensitive, wetlands, VULNERABLE | 2.9 |
| c. Sensitive, wetlands, ENDANGERED | 6.0 |
| d. ENDANGERED species, fisheries | 9.0 |

Health and Safety Impacts

- | | |
|--|-----|
| a. Small population around port | 1.0 |
| b. Medium - large population around port | 2.8 |
| c. Large population, bridges | 6.0 |
| d. Large DEPENDENT population | 9.0 |

Analysis:

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The purpose of Book 3 is for the participants to calibrate a risk assessment scale for each risk factor. For each risk factor there is a low (Port Heaven) and a high (Port Hell) severity limit, which are assigned values of 1.0 and 9.0 respectively. The participants determined numerical values for two intermediate qualitative descriptions between those two extreme limits. On average, participants from this port evaluated the difference in risk between the lower limit (Port Heaven) and the first intermediate scale point as being equal to **1.5**. The difference in risk between the first and second intermediate scale points was equal to **2.9**; and the difference in risk between the second intermediate scale point and the upper risk limit (Port Hell) was **3.7**.

Book 4 - Risk Factor Ratings (*Philadelphia*)

This is the point in the workshop when the process begins to address local port risks. The participants defined the geographic bounds of the port area to be discussed as:

From the Traffic Separation Lanes seaward of the Delaware Capes through Delaware Bay and River northward to Trenton, NJ. Includes the Chesapeake & Delaware Canal (to the Maryland border) and navigable portions of the Schuylkill River (to Fairmount Dam), Salem River & Canal, and the Christina River.

There was some initial concern raised over the geographic boundaries to be included in the discussion based on differing operating parameters of the lower and upper Delaware Bay and River. Participants believed that a certain loss of detail would ensue as a result of the scope of the PAWSA. However, the participants determined that, due to insufficient representation, a division of the participants into two groupings by upper and lower area would further hinder the process and chose to discuss the upper and lower river area together.

After a discussion of approximately one-third of the risk factors, the workshop was stopped. Had the workshop continued, the participants would have used the scales developed in Book 3 to assess the absolute level of risk in their port for each of the 20 risk factors. Based on the input from the participants, the top risks to port safety in Philadelphia would have been listed here.

Book 5 – VTM Tools (*Philadelphia*)

This part of the workshop determines the risk gap for a particular risk factor relative to the risk gap for the other factors as determined by the participants. Risk gap is the variance between the existing level of risk for each factor determined in Book 4 and the average acceptable risk level as determined by each participant team.

Where they think the existing level of risk needs to be reduced, the participant teams select appropriate VTM tools, or identify other actions, that they think will help mitigate the identified risk factor. These VTM tool selections include:

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- Improving the Aids to Navigation
- Improving Communications
- Improving Rules and Regulations
- Improving Static Navigation Information
- Improving Dynamic Navigation Information
- Establishing a Vessel Traffic Information System
- Establishing a Vessel Traffic System
- Other solutions that are not VTM in nature

In this way, the participant teams clearly rank order and quantify risk in their port, and identify the most appropriate manner to address those risks.

The participants did not complete this part of the process.

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Summary of Philadelphia Waterway Navigational Attributes†

- ❖ ***Ship Channel Complexity:*** Very long (over 110 nautical miles) with many severe bends and turns.
- ❖ ***Converging or Crossing Traffic:*** Moderate and Light.
 - Moderate in the following areas: Lower Delaware Bay, near Reedy Point; Delaware River, near Wilmington / Marcus Hook / Mantua Creek, and Kaighn's Point anchorages, and near the entrance to the Schuylkill River.
 - Light in the remainder of the bay.
- ❖ ***Ship Channel Configuration:*** Generally narrow, and dredged to a project depth of 40 feet.
 - The channel width is 1,000 feet the first 35 NM from sea.
 - The channel is 800 feet wide from 35 NM to 84 NM (Walt Whitman Bridge.)
 - It is 400 feet wide from 84 to 109 NM (at Newbold Island.)
 - Upriver of this, the channel width varies from 500 to 200 feet, with a 25 foot depth.
- ❖ ***Ship Channel Traffic:*** Moderate (approximately 3,000 ship arrivals per year.)
- ❖ ***Recreational and Local Fishing Activity:*** Seasonally heavy, especially in the lower bay and near the Chesapeake & Delaware Canal.
- ❖

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- ❖ **Bottom:** Varies in the port:
 - Delaware Bay: Primarily sand and shell with some hardpan.
 - Middle Bay and River: Mostly sand and mud with some rocks.
 - Upper Delaware River: Mostly mud with some rocks.
- ❖ **Currents:** Moderate to strong currents that run parallel to the main ship channel.
- ❖ **Wind:** Strong northwesterly winds prevail November through March. Prevalent southerly winds in summer reaching 15-25 knots. Gale force winds are experienced from 1-3% of the time.
- ❖ **Visibility:** Advection fog can be present in spring and early summer. The visibility is worst December through June. Fog is most frequent April through June, dropping below 0.2 NM about 3% of the time. Visibility below 2 NM is most likely in January and February because of precipitation, and particularly snow. Fog is less likely July through September.

Philadelphia Vessel Traffic Management Profile† (Presently in Place)

- ❖ **Aids to Navigation (USCG and Private)**
 - Lighted & Unlighted – Fixed & Floating
 - Electronic Aids: GPS, DGPS, RACON
 - Range lights
 - Traffic Separation Schemes (TSS) –IMO
 - Regulated Navigation Areas (RNA) – USCG:
 - Lighthouses – USCG
 - Seasonal buoys - USCG
- ❖ **Vessel Traffic Systems (VTIS/VTIS):** No USCG Vessel Traffic System. VTIS operated by the Pilot's Association for the Delaware Bay & River presently provides basic coverage of the sealane approaches to the Delaware Capes and of the lower Delaware Bay. Upgrades to this system will extend the offshore coverage area to approximately 24 NM offshore from Cape Henlopen.

❖ ***Situation Awareness (Each Ship)***

- Own Ship's & Other Ship's Position
- Other ship's intentions
- Waterway configuration
- Environmental conditions

Philadelphia Planned and Anticipated Changes†

❖ ***Planned Infrastructure Developments:***

- US Army Corps of Engineers' Channel Deepening Project will increase the project depth to 45 feet from sea to Philadelphia.
- A RoRo berth is to be constructed adjacent to the main ship channel at the Port of Wilmington.
- An aerial tramway crossing the Delaware River will be built from Penn's Landing to Camden, NJ.
- A FASTSHIP terminal is planned for construction at Port Richmond.

❖ ***Changes in levels and/or nature of waterway activities:*** None.

❖ ***Forecast Traffic Levels:***

- Ship arrivals expected to remain at 3,000 per year.
- Tug and tow traffic will increase marginally.

❖ ***USCG Regulations to be implemented:*** None presently.

❖ ***Changes under consideration, but not committed:*** None.

† Prepared by MSO Philadelphia